A STUDY ON INTERNATIONAL TRANSPORT DEMAND FORECASTING ALONG ASIAN HIGHWAY (AH) NO-1 ROUTE

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ABSTRACT

Asian Highway (AH) plan is expected to promote the international transportation demand among Asian countries and to accelerate unification of Asian economy. In spite of these expectations, few researches have studied to evaluate the impact of AH plan.

In this regards, the study focuses on a part of the AH1 route (i.e., South Korea-North Korea-China) and attempts to conduct latent demand forecasting for international passenger travel. Stated preference (SP) survey was performed against international passengers between South Korea and China. The SP survey was carefully designed with several assumptions to incorporate the unique status of South and North Korea to the mode choice models of international passenger travel.

Subject cities include: Seoul and Busan for South Korea, and Dandong, Shenyang, Dalian, Changchun, Beijing and Teijin for China. Disaggregate analysis was applied to develop mode choice models of international passenger travel. Some results showed that the AH1 route can significantly affect future international passenger travel demand.

1. INTRODUCTION

Asian Highway (AH) Plan by the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) is a plan to cover the international road networks from eastern Asia to Turkey via the Eurasian Continent. Parts of existing artery road networks in participating countries will be newly positioned as parts of international road network. AH Plan is expected to promote the international transportation demand among Asian countries and to accelerate unification of Asian economy. In spite of these expectations, few researches have studied to evaluate the impact of AH plan.

In this regards, the study focuses on a part of the AH1 route connecting between South Korea, North Korea and China. In particular, the study attempts to evaluate the impact of AH1 route to the international passenger travel demand between South Korea and China. More specifically, the study is to analyze and forecast the variations of mode shares of South Korea and China due to the open of AH1 route.

In reality, some difficulties exist to study the demand forecast of AH1 route due to the unique status between South and North Korea [4][5]. At present, the travel modes available between South Korea and China are restricted to international flight and international ferry, because land transports, such as arterial road and railway, between South and North Korea are strongly prohibited. This fact results in the restriction of land transport of international passenger travel between South Korea and China.

The study, however, was motivated by the agreement of ‘Mutual use and refurbishment of Gaesung-Pyongyang expressway’, a part of AH1, which had agreed during the South and North Korea summit talk in 2007. Road investigation in North Korea side has been preceded according to the agreements. Accordingly, the mutual use of Gaesung-Pyongyang expressway is expected to activate exchange between South and North Korea and the fact results in to relief the restriction of land transport of international passenger travel between South Korea and China.

To achieve the research purpose, the study starts with several assumptions on the available conditions of land transports between South and North Korea.

1. International bus using AH1 route is available for International passengers between

South and North Korea, but private car is not available.
2. International railway is available for International passengers between South and North Korea.
3. It is not allowed to visit any places of North Korea during international travel

To analyze the impacts of AH1 route, stated preference (SP) survey was performed against international passengers between South Korea and China. The SP survey was carefully designed with several assumptions to incorporate the unique status of South and North Korea to the mode choice models for international passenger travel.

Disaggregate analysis was applied to develop mode choice models of international passenger travel. A total of four modes are considered; International flight, international ferry, international bus and international railway. The study proposed several hierarchical structures to effectively represent international passenger's behavior of mode choice, and then select a best model with the highest goodness of fit.

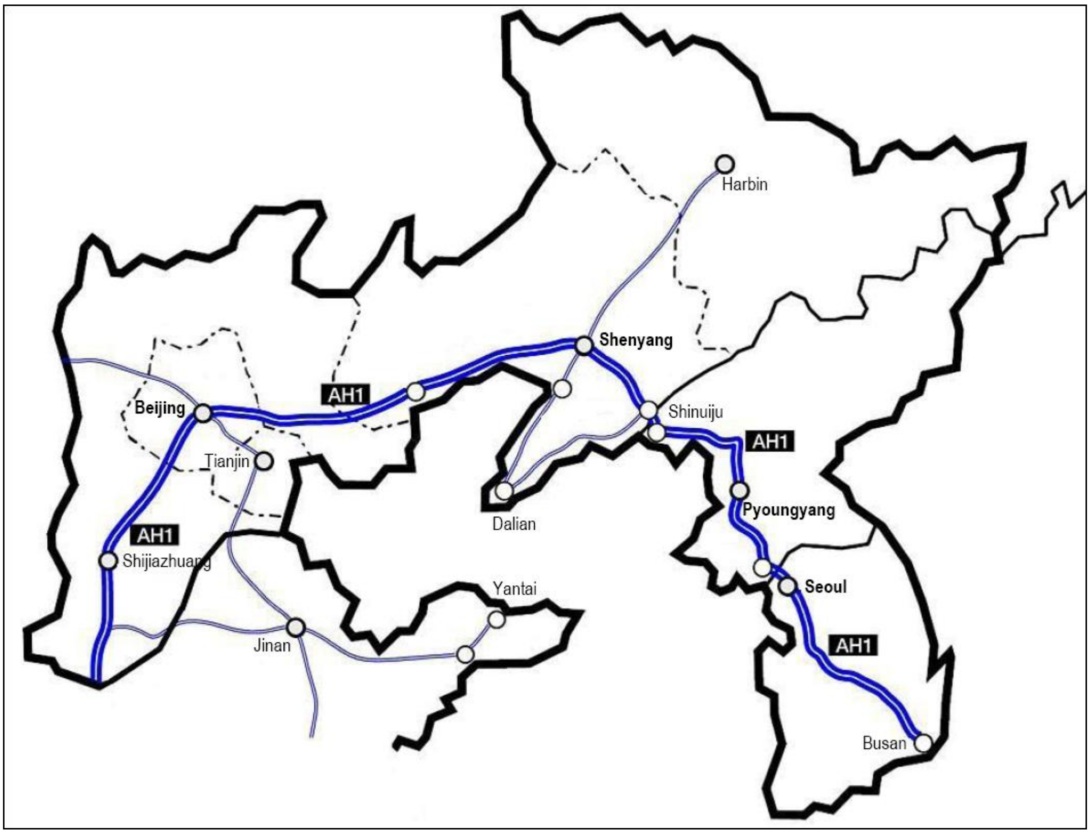
The paper will be structured as follows. First, we will describe the SP survey and the sample. Section 3 then describe the methodology to develop mode choice models for international passenger travel. This followed by Section 3 which reports the main findings of the empirical analysis. Finally, the last section discusses the major conclusions and identifies remaining problems for future research.

2. STATED PREFERENCE (SP) SURVEY

2.1 Subject Area

The analysis under study focuses on international passenger travel between South Korea and China. The spatial scope of the present study is limited to South Korea and the northeast provinces of China as shown in Figure 1. Subject cities along with AH1 route include; Seoul for South Korea and Dandong, Shenyang, Dalian, Changchun, Beijing and Teijin for China. Other cities (e.g., Busan, Shijiazhuang, Jian, Yantai, etc.) are excluded by considering the distance using international bus.

Figure 1. Subject cities (AH1 route)



2.2 SP Design

A discrete choice model is commonly used for studies related to transport demand and choice behavior, using directly observed transport demand. In the analysis of latent transport demand or service alternatives, however, SP data is widely used to analyze the demand features of new transport system because the preference, opinion and intension of each decision maker can be taken into analysis.

When SP method is adopted for the study, some factors, such as, subject, number of sample, representation method of respondent preference, choice alternative and its number, attribute variable and its number, level of the attribute variable and its number, combination method of virtual scenarios, and number of questions, should be determined. Among them, especially, the level and the number of attribute variable are the most important factors which govern the number of questions.

In SP design, table of orthogonal arrays of 'experimental design method' makes the variables are mutually independently distributed in the choice alternative. This result comes from the 'experimental design method', which is based on the premise that it is possible to analyze the principal effects of the variables under the assumption that various attributes are mutually independently distributed in the choice alternatives not giving confounding effects to the preference.

The factors of travel time and travel cost were applied and each factors set up for three levels, respectively. A total of 132 SP cards, combinations of the factors, were derived from the table of orthogonal arrays of experimental design method, neglecting unreasonable combinations. For each questionnaire, respondents were asked to response for at least four SP cards, randomly selected from 132 SP cards.

2.3 Define the levels of SP factors

For the determination of the SP factors, it was first assumed that travel time and travel cost were the most important factors of determining international passenger's behavior of mode choice. In addition, we assumed that travel time and travel cost for the international flight and ferry fix to effectively evaluate the impact of AH1 route. .

The levels of SP factors are defined based on the actual operation conditions of subject countries, excepting the road and railway conditions of North Korea. That is, for international flight and ferry, the levels of travel time and travel cost are defined based on the operation conditions of Incheon international airports and Incheon international harbors. For the land transports of South Korea and China, the levels are defined in corresponding with intercity railway and bus. However, for land transports in North Korea, the levels were designed based on intercity railway and bus in South Korea.

The variations of factor levels were defined corresponding with the improvement levels of AH1 route and railway systems in North Korea. More specifically, the operating speed for international bus was set to 80km/h, 100km/h, and 120km/h, and for international railway was set to 60km/h, 80km/h, and 100km/h. In addition, the future plan of high speed railway in Northeast China, 200km/h maximum speed, was incorporated to define the levels of factors [3].

Table 1 showed the variation of the time and travel cost of Seoul-Shinuiju and Seoul-Pyongyang routes in corresponding with the improvement levels. The levels of travel time were calculated based on the operating speed and for travel cost based on the fare rates (won/km) of intercity bus and railway in South Korea. Finally, Table 2 showed the levels of SP factors for international passenger travel by road and railway [7] [8] [9] [10] [11].

Table 1. Variations of the travel time and travel cost of Seoul-Shinuiju and Seoul-Pyongyang routes

	Route	Distance (km)	Travel time			Travel cost		
			Level 1 (base)	Level 2	Level 3	Level 1 (base)	Level 2	Level 3
Road	Seoul-Pyongyang	224	2h 10m	2h 50m	1h 50m	₩19,000	₩17,000	₩21,000
	Seoul-Shinuiju	465	4h 40m	5h 50m	3h 50m	₩38,000	₩35,000	₩40,000
Railway	Seoul-Pyongyang	262	3h 20m	4h 20m	2h 40m	₩16,000	₩13,000	₩18,000
	Seoul-Shinuij	487	6h 10m	8h 10m	4h 50m	₩30,000	₩25,000	₩33,000

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Table 2. The levels of SP factors for international passer travel by road and railway

	Route	Distance (km)	Travel time			Travel cost		
			Level 1 (base)	Level 2	Level 3	Level 1 (base)	Level 2	Level 3
Road	Seoul-Dandong	465	4h 50m	6h 00m	4h 00m	₩38,000	₩30,000	₩43,000
	Seoul-Shenyang	690	8h 10m	9h 20m	7h 20m	₩57,000	₩50,000	₩62,000
	Seoul-Dalian	845	9h 10m	10h 20m	8h 20m	₩69,000	₩62,000	₩74,000
	Seoul-Changchun	1,005	12h 10m	13h 20m	11h 20m	₩83,000	₩76,000	₩88,000
	Seoul-Beijing	1,348	20h 10m	21h 20m	19h 20m	₩111,000	₩103,000	₩116,000
	Seoul-Tianjin	1,472	22h 10m	23h 20m	21h 20m	₩121,000	₩114,000	₩126,000
Railway	Seoul-Dandong	487	6h 10m	8h 10m	5h 00m	₩30,000	₩15,000	₩39,000
	Seoul-Shenyang	722	7h 20m	9h 20m	6h 10m	₩71,000	₩55,000	₩82,000
	Seoul-Dalian	785	7h 30m	9h 30m	6h 20m	₩81,000	₩65,000	₩91,000
	Seoul-Changchun	1,064	9h 00m	11h 00m	7h 40m	₩116,000	₩100,000	₩126,000
	Seoul-Beijing	1,528	11h 20m	13h 20m	10h 10m	₩196,000	₩180,000	₩206,000
	Seoul-Tianjin	1,686	12h 10m	14h 10m	11h 00m	₩213,000	₩197,000	₩223,000

2.4 Field Survey

A questionnaire survey was conducted at Incheon international harbor and Incheon international airport from 6th October to 8th November in 2008. A total number of 540 samples were collected and of this, 498 samples were available for the analysis.

The respondents were questioned about their destinations, trip purposes, travel mode and travel time and travel cost of their modes. In addition, the SP survey was also performed. The respondents were asked to respond the most preferred mode for the SP cards, randomly given from the interviewers.

As results of SP survey on the preference of transport mode for traveling South Korea and China and South according to use of AH1 route and railway network in future, it is found for case of South Korea and China that preference of international railway, flight, bus and ferry were 49.2%, 33.8%, 15%, and 2%, respectively. Table 3 shows that detailed responds on preferred modes for international passenger travel.

Table 3. Actual Mode Shares in SP survey

			Intl. bus	Intl. railway	Intl. flight	Intl. ferry	Total
Korea - China	Seoul-Dandong	Frequency	43	53	-	-	96
		Share (%)	44.8	55.2	-	-	100
	Seoul-Shenyang	Frequency	70	206	83	1	360
		Share (%)	19.4	57.2	23.1	0.3	100
	Seoul-Dalian	Frequency	53	184	131	8	376
		Share (%)	14.1	48.9	34.8	2.1	100
	Seoul-Changchun	Frequency	71	256	91	4	422
		Share (%)	16.8	60.7	21.6	0.9	100
	Seoul-Beijing	Frequency	44	139	160	13	356
		Share (%)	12.4	39.0	44.9	3.7	100
	Seoul-Tianjin	Frequency	25	166	224	15	430
		Share (%)	5.8	38.6	52.1	3.5	100
	Total	Frequency	306	1,004	689	41	2,040
		Share (%)	15	49.2	33.8	2	100

3. MODE CHOICE MODELS FOR INTERNATIONAL PASSENGER TRAVEL

3.1 Methodology

To improve the accuracy of estimated future demand, this study uses a model which is able to consider the competition among various transport modes. Two disaggregate models based on the rational choice behavior of individuals are applied to forecast passenger demand: One is Multiple Logit (ML) model for two more alternative choices and the other is Nested Logit (ML) model to take the correlation of alternatives into account in analysis [2].

The utility function is commonly composed of two components: one component V_j is the deterministic (or observable) portion of the utility and the other ε_j is the error of the utility unknown to the analyst. Based on an assumption of linear relationship between utility and these two components, the choice probability on an alternative and the utility function can be expressed as the below equation (1.1) and (1.2).

$$P = \Pr\lfloor U_i \succ U_j \rfloor \quad (1)$$

$$U_j = V_j + \ni_j \quad (2)$$

In addition, the probability *P* of an individual (or decision maker) *t* choosing alternative *j* against alternative *i* is as follows:

$$\begin{aligned} P_i &= \Pr[U_i \succ U_j] = \Pr[V_i + \ni_i \succ U_j + \ni_j] \quad (1.3) \\ &= \Pr[\ni_i + V_i - V_j \succ \ni_j] \\ &= \Pr[\ni_i = \eta, \ni_j \prec \eta + V_i - V_j], \; -\infty \prec \eta \prec \infty \end{aligned}$$

Because the distribution of the error term is composed of several unobservable factors at the same time, the most common assumption for error distributions in the statistical and modeling literature is that errors are distributed normally. However, the normal distribution assumption for error term leads to the Probit model which has some properties that make it difficult of use in choice analysis. For the reason of computational advantage, Logit model based on the Gumbel distribution is commonly used. The assumed distribution for effort term is given to

$$\psi(\eta) = \Pr[\ni_i \leq \eta] = \exp[-\exp(-\eta)] \quad (1.4)$$

To summary, the probability *P* of an individual *t* choosing alternative *j* against alternative *i* is finally as follows:

$$P_{i,t} = \frac{\exp(V_i)}{\exp(V_i) + \exp(V_j)} \quad (1.5)$$

In case of ML model having two more alternatives under study, the probability *P* of the individual *t* choosing alternative *j* against alternative *i* can be expressed as the below equation (1.6).

$$P_{i,t} = \frac{\exp(V_i)}{\sum_{j=1}^{J} \exp(V_j)}, \text{ in } i, j \in J \quad (1.6)$$

Even though ML model is widely used to forecast traffic demand and behavior, it is necessary to use various disaggregate models in consideration of the characteristics of analysis concern. In this context, it should be taken into account in this study that the competition of road and railway for mode choice of freight transport and future passenger, the competition of ferry (marine transport) and land transport (road and railway), and various inter-correlations among alternatives, which is hard to be applicable to the existing ML model. Hence, NL model is additionally proposed to consider the mutual

relation among alternatives under study.

In case of NL model, the probability *P* of an individual *t* choosing alternative *m* is the conditional probability that the choice *d* at the first level and then the choice *m* at the second level, which can be expressed as the equation (1.7).

$$P_t(dm) = P_t(m|d)P_t(d) \tag{1.7}$$

$$P_t(m|d) = \frac{e^{(V_m + V_{dm})\mu^m}}{\sum_{m' \in M_{td}} e^{(V_{m'} + V_{dm'})\mu^m}}, \tag{1.8}$$

$$P_t(d) = \frac{e^{(V_d + V'_d)\mu^d}}{\sum_{d' \in D_t} e^{(V_{d'} + V'_d)\mu^d}}, \tag{1.9}$$

$$V'_d = \frac{1}{\mu^m} \ln \sum_{m \in M_{td}} e^{(V_m + V_{dm})\mu^m} \tag{1.10}$$

In NL model, the mutual relation among error terms is defined as the scale parameter μ which is used to determine the validity of estimated model. If the value falls within 0~1, then the estimated model is accepted to be valid. The structure of ML model could be defined by an analyst in various types and the best model structure should be determined based on the goodness-of-fit and the rationality of estimated parameters.

$$0 \prec \mu \prec 1, \text{ in } \mu = \mu^d / \mu^m \tag{1.11}$$

Utility functions of the study can be defined as follows.

$$V_{flight} = Const_{flight} + \beta_{time} * T_{time}^{flight} + \beta_{\cos t} * T_{\cos t}^{flight} \tag{1.12}$$

$$V_{Bus} = Const_{Bus} + \beta_{time} * T_{time}^{Bus} + \beta_{\cos t} * T_{\cos t}^{Bus} \tag{1.13}$$

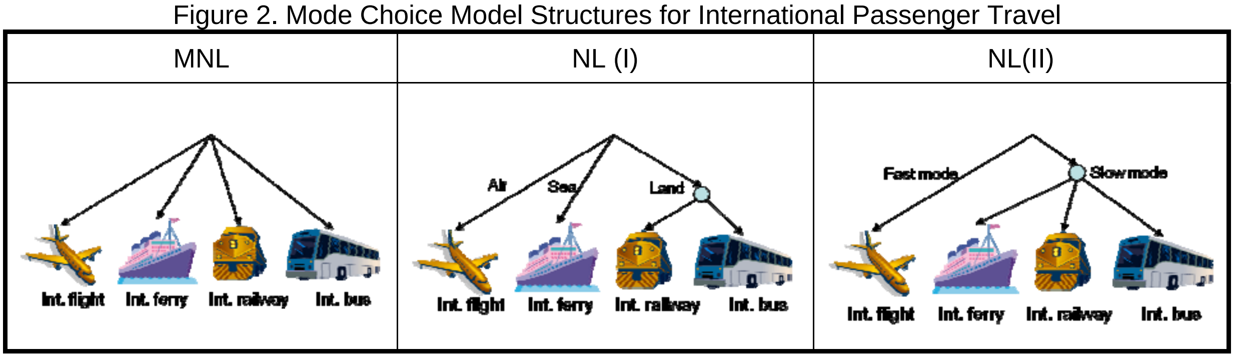
$$V_{ferry} = Const_{ferry} + \beta_{time} * T_{time}^{ferry} + \beta_{\cos t} * T_{\cos t}^{ferry} \tag{1.14}$$

$$V_{railway} = \beta_{time} * T_{time}^{railway} + \beta_{\cos t} * T_{\cos t}^{railway} \tag{1.15}$$

where, $Const_i, \beta_{time}, \beta_{\cos t}$ represent vectors of estimable coefficients. T_{time}^{i} and $T_{\cos t}^{i}$ represent vectors of exogenous variables for mode i (i=4).

Base on the proposed utility functions for each transportation mode, in case of mode choice model for South Korea and China passengers, a MNL and two NL models were applied to include the competition between transportation modes (e. g., road and railway), which produce the optimal model structure (See Figure 2).

Figure 2. Mode Choice Model Structures for International Passenger Travel



4. ESTIMATION RESULTS

4.1 Model Selection

The study attempts to select the best model for representing the international passenger behaviors of mode choices. The SP data of respondents were applied for the estimation. The estimation results of the three models are shown in Table 5.

For the estimation results of mode choice models for South Korea and China, it is found that *t*-values of travel time and travel cost are significant at the 95% confidence level across all estimated models. In addition, the coefficients of travel time and travel time variables have negative signs; meaning that respondents prefer a corresponding mode of shorter travel time and cheaper travel cost.

To represent the hierarchical structure of mode choice for international passenger travel, two NL models are estimated. NL(I) assumed that at first respondents choose if they prefer air, sea or land transports, and then choose one of international bus and railway in the case of choosing land transports. NL(II) assumed that at first respondents choose if they prefer fast or slow mode, and then choose one of International ferry, bus and railway in the case of choosing slow mode.

The significance of the proposed NL models is evaluated by the scale parameters (μ). The estimation results of two NL models shows that the values of scale parameters are located in the range between 0 to 1 and significant at the level of significance more than 99%, which means that the proposed modeling structures were available.

The comparison of the adjusted R-squared ($\bar{\rho}^2$) of two NL models shows that the NL(I) model is more appropriate in the analysis of international passenger behaviors of mode choice (see Table 5). Therefore the estimation results of NL(I) are applied for the further analysis.

Figure 4 shows the predicted mode share of international passenger travel between South Korea and China. The level of travel time and travel cost to calculate mode share are based on the conditions of level 1 of Table 1.

The results of the predicted mode share can be represented as follows. The mode share of international railway of international passenger travel between South Korea and China is about 56%~64% which is the highest compared to other modes.

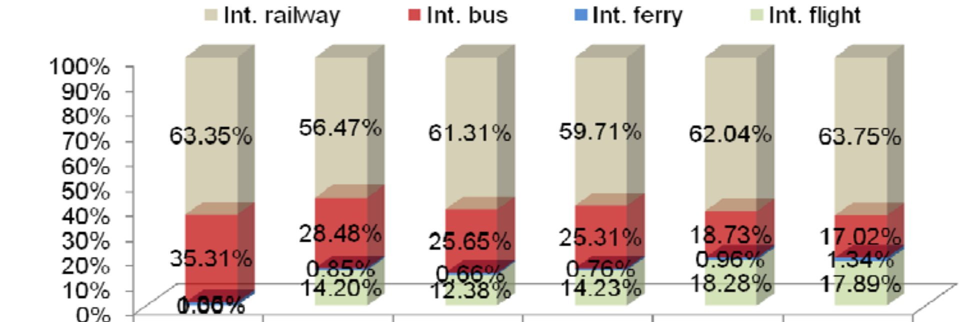
For the international bus, the mode share is about 35%. The international bus seems to be more preferred for relatively shorter distance international travel because the mode share for Dandong City is the highest but it is decreasing as the distance increase. In addition, the international bus is competitive with the international flight in the middle distance international passenger travel.

Table 5. Estimation Results of Mode Choice Models

Explanatory Variables	**MNL**		**NL(I)**		**NL(II)**	
	Coef.	T-value	Coef.	T-value	Coef.	T-value
$Const_{flight}$	-0.074	-0.279	0.221	0.592	-0.048	-0.168
$Const_{bus}$	-0.936	-10.588*	-0.923	-10.176*	-0.929	-10.387*
$Const_{ferry}$	-1.561	-6.691*	-4.374	-2.766*	-1.184	-3.387*
Time (minutes)	-0.002	-8.575*	-0.003	-4.491*	-0.002	-5.995
Cost (10,000won)	-0.053	-4.882*	-0.142	-3.161*	-0.077	-3.906*
Scale parameter(μ)	-	-	0.439	3.581*	0.713	4.711*
Log-likelihood at initial		-2733.881		-2733.881		-2733.881
Log-likelihood at convergence		-2066.498		-2063.921		-2065.520
R squared (ρ^2)		0.244		0.245		0.244
Adjusted-R squared ($\bar{\rho}^2$)		0.242		0.243		0.242
Number of observations		1992		1992		1992

(*) Level of significance greater than 95%

Figure 4. The predicted mode share of international passenger travel between South Korea and China



	Seoul-Dandong	Seoul-Shenyang	Seoul-Dalian	Seoul-Changchun	Seoul-Beijing	Seoul-Tianjin
Int. railway	63.35%	56.47%	61.31%	59.71%	62.04%	63.75%
Int. bus	35.31%	28.48%	25.65%	25.31%	18.73%	17.02%
Int. ferry	1.35%	0.85%	0.66%	0.76%	0.96%	1.34%
Int. flight	0.00%	14.20%	12.38%	14.23%	18.28%	17.89%

4.2 Elasticity

Based on the estimation results of NL(I), the elasticity of international passenger behaviors of mode choice was analyzed in the section. To set up the scenarios, the operating speed of the international railway and the international bus in North Korea (Seoul~Shinuiju) area were set from 60 to 100km/h, and the speed was changed in every 20km/h. However, the characteristics of international flight and ferry in South Korea and China are fixed.

Table 6 shows the estimation results of elasticity analysis according to the scenarios. It is shown from the results that international bus using AH1 route has some competition with international railway in comparatively shorter distance. However, international railway is highly preferred under all scenarios except for the Seoul~Pyongyang travel, which imply that the international railway should be considered as the primary alternative for constructing international networks..

Table 6. Elasticity of Mode Share of international passenger travel between South Korea and China (%)

	Korea-Shenyang		Korea-Dalian		Korea-Changchun		Korea-Beijing		Korea-Tianjin	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Intl. bus	20.66	31.70	18.32	28.72	17.62	28.34	13.00	21.22	11.72	19.36
Intl. railway	63.85	53.63	68.24	58.58	66.89	57.06	67.11	60.01	68.39	61.87
Intl. flight	14.61	13.84	12.76	12.06	14.70	13.87	18.90	17.83	18.50	17.46
Intl. ferry	0.88	0.83	0.68	0.64	0.78	0.74	0.99	0.94	1.39	1.31

5. CONCLUSIONS

AH plan is expected to promote the international transportation demand among Asian countries. In spite of this expectation, few researches have studied to evaluate the impact of AH plan. The study was motivated by the agreement of 'Multual use and refurbishment of Gaesung-Pyongyang expressway' between South and North Korea. The aim of the study is to analyze the impact of AH plan, especially focusing on the AH1 route (i.e., South Korea-North Korea-China). In reality, however, many difficulties exist to study the impact of AH1 route.

With the assumption of using Gaesung-Pyongyang expressway in North Korea, the AH1 route will be contributed to progress not only interchanging-cooperation between South and North Korea, but also the cooperation among the North-East Asia.

The study developed mode choice modes of international passenger travel based on the SP survey data. SP survey is carefully designed with several assumptions to incorporate the unique status of South and North Korea to the mode choice models. In addition, the SP survey was performed against international passengers of Korean and Chinese. The levels of SP factors, travel time and travel cost, are defined based on the actual operation conditions of subject countries, except for the road and railway conditions of North Korea.

To overcome the limitations of the existing ML method, NL model is additionally proposed to take various competitions among alternatives into account in analysis.

As analysis results, the validity of estimated models was confirmed because the coefficients of models were statistically significant and the goodness-of-fit were acceptable. Thus, the proposed hierarchical model of international passenger behavior of mode choice can be useful for the forecasting passenger demand according to situational changing of South and North Korea and North-East Asia.

Based on the results of model estimation, it is found that NL(I) model is the best model to estimate to passenger mode choice in South Korea and Northeast China under study. The results represent that at first respondents choose one of air, sea or land transports, and then choose one of international bus and railway in the case of choosing land transports.

In case of South Korea and Northeast China passenger travel, the international train has high competition (about 65%) compared to other modes and the international bus has higher attractiveness (about 34%) for shorter distant travel (e.g., Seoul~Dandong cities).

Because SP data was performed with the assumption that AH1 route would be completely in serve, there are some limitations under study that the inherent bias of SP survey, respondents' uncertainty about North Korea.

To improve applicability of the models proposed in the study, it needs to include more reliable variables based on various RP survey, and a careful review by specialists and systematically reliable target selection for SP survey should be supplemented.

REFERENCE

1. Backler G. G. 1987. *The Relationship between Railway Loading-gauge Constraints and Modal Split in the Anglo-European United Freight Market*. Ph. D. thesis. University of Leeds

2. Ben-Akiva, M and S. R. Lerman. 1985 *Discrete Choice Analysis: Theory and Application to Travel Demand*. The MIT Press

3. Korea expressway Corporation. 2008. *Research for Transport Demand Forecasting in AH1 Route (Seoul-Shinuiju)*

4. Nak-moon Sung, Yeon-kyu Kim and Byung-min Ahn. 2005. *Analysis of Traffic and Cost of Inter-Korean Connecting Roads and Railways*. The Korea transport Institute

5. Won-Bae Kim, Sung-Wook Hong and Kyung-Min Nam. 2001. *Building Infrastructure for the facilitation of Economic Cooperation in Northeast Asia in the 21st Century*. The Korea Research institute of Human Settlements

6. Won-ik Ha and Gi-chan Nam. 1996. "Modal Choice Models for freight Transportation Using SP Data". *Journal of Korean Society of Transportation*. Vol. 14(1). Korean Society of Transportation

7. http://www.incheonferry.co.kr

8. http://www.airport.or.kr

9. http://www.chinatrain.co.kr

10. http://www.8864.cn

11. http://www.korail.com